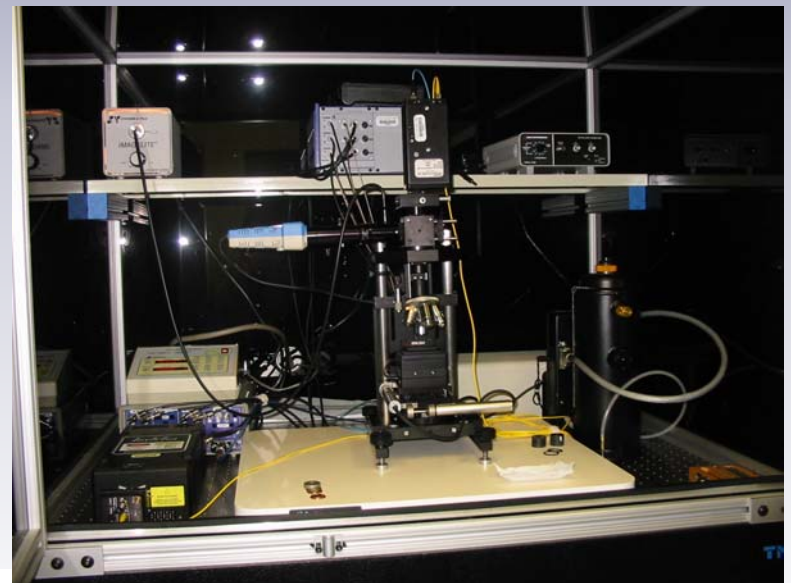


POLYMER INTERPHASE CONSORTIUM: NEXT PHASE PROPOSAL

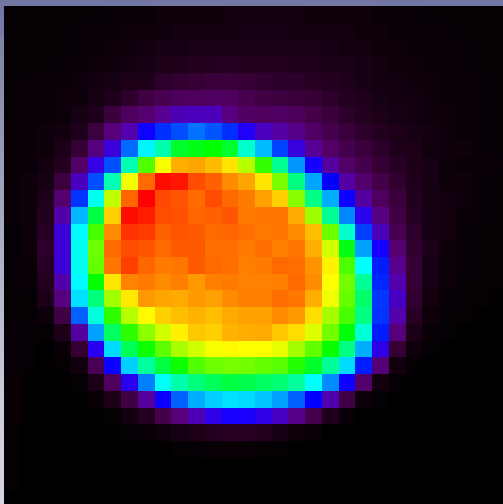
APPLICATION AND DEVELOPMENT OF PHOTON-BASED IMAGING TECHNIQUES FOR CHARACTERIZATION OF THE CHEMICAL AND MORPHOLOGICAL MICROSTRUCTURE OF POLYMERIC MATERIALS

- APPLICATION OF ESTABLISHED TECHNIQUES TO MICRO-CHARACTERIZATION OF CONSORTIUM MATERIALS
- DEVELOPMENT OF NOVEL IMAGING TECHNIQUES AND EXPLORATORY APPLICATION TO CONSORTIUM MATERIALS
- FUNDAMENTAL AIM IS TO MAP SPATIAL DISTRIBUTION OF CHEMICAL COMPONENTS IN HETEROGENEOUS MATERIALS AND STRUCTURAL QUANTITIES SUCH AS ALIGNMENT, STRAIN AND CRYSTALLINITY ON NANO AND LARGER LENGTH SCALES.

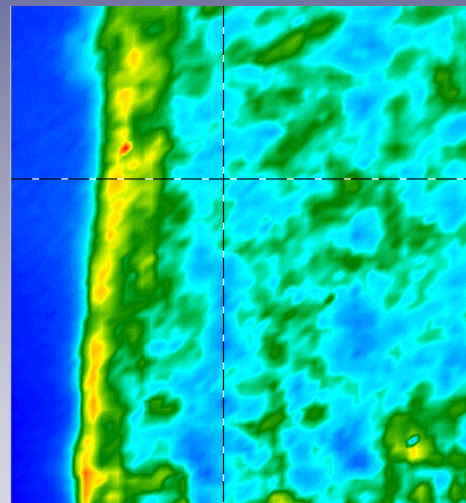


CHEMICAL IMAGING: SPATIALLY RESOLVED VIBRATIONAL SPECTROSCOPY

- CONFOCAL MICROSCOPY COUPLED WITH RAMAN OR INFRARED ABSORPTION SPECTROSCOPY
- SPECTROSCOPY \Rightarrow CHEMICAL COMPOSITION AND STRUCTURE (STRAIN, CRYSTALLINITY)
- MICROSCOPY \Rightarrow HIGH SPATIAL RESOLUTION: RAMAN $\sim 1\ \mu\text{m}$, IR $\sim 10\ \mu\text{m}$



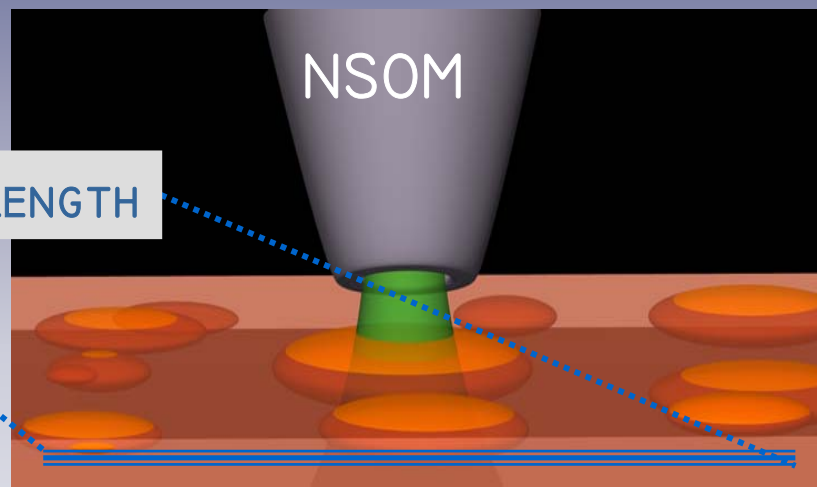
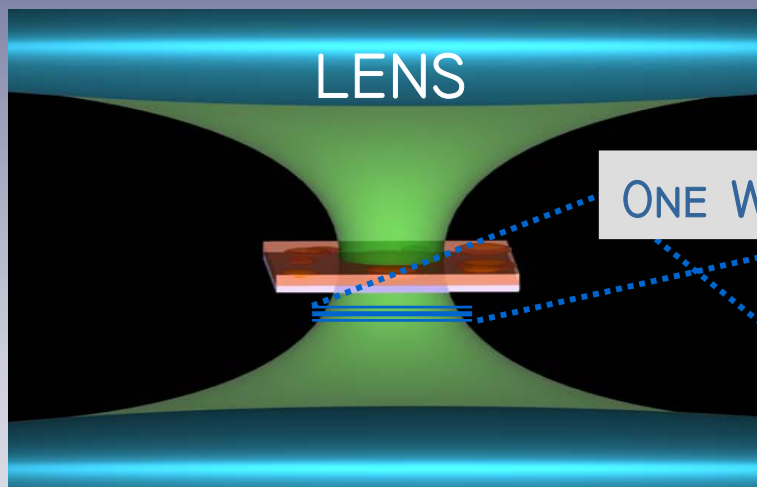
- RAMAN IMAGE OF NOMEXTM FIBER CROSS SECTION IN EPOXY MATRIX
- 32 x 32 μm IMAGE ($\sim 1\ \mu\text{m}$ SPATIAL RESOLUTION)
- RAMAN SPECTRA REVEAL RADIAL VARIATION IN FIBER CRYSTALLINITY



- IR ABSORBANCE IMAGE OF MICROTOMED THERMOPLASTIC OLEFIN SECTION
- 325 x 325 μm IMAGES $\sim 10\ \mu\text{m}$ SPATIAL RESOLUTION
- OH STRETCH IMAGE REVEALS FILLER (TALC) RICH SURFACE LAYER

NANOSCALE CHEMICAL IMAGING: NEAR FIELD MICROSCOPY

- NEAR-FIELD MICROSCOPY: NANOSCALE SPATIAL RESOLUTION
- CONTRAST MECHANISMS: SCATTERING, FLUORESCENCE, RAMAN, IR ABSORBANCE
- KEY ISSUES: SAMPLE PREPARATION AND SIGNAL MAGNITUDES

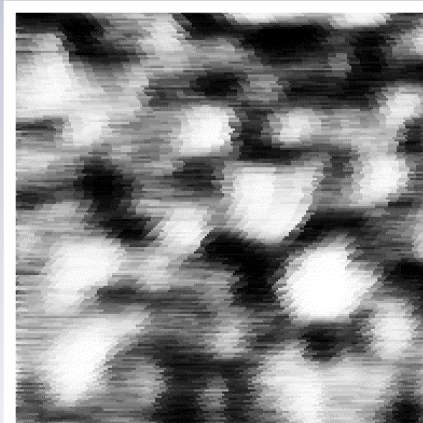
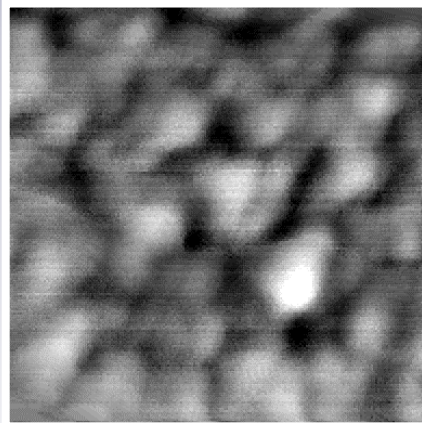
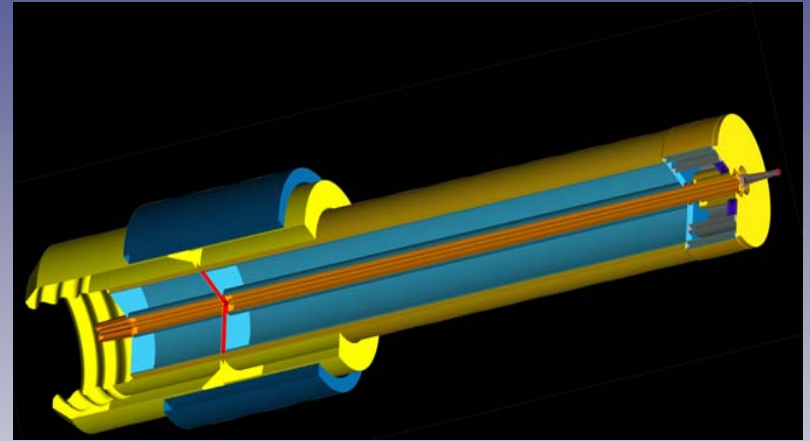
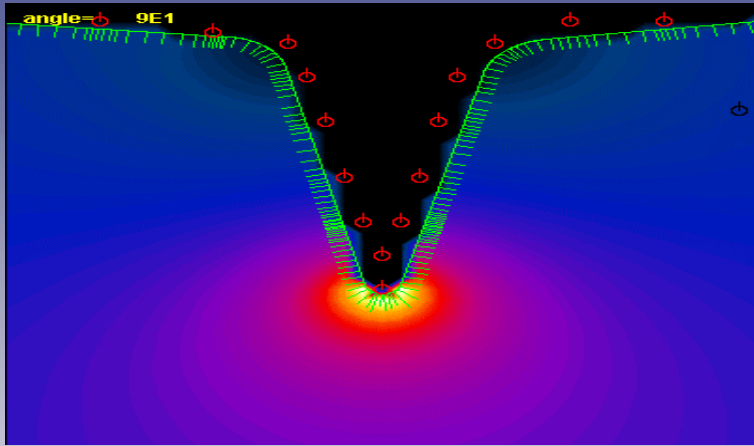


MICROSCOPY/SPECTROSCOPY WITH LENSES:
LATERAL RESOLUTION IS LIMITED BY
DIFFRACTION: $\sim \frac{1}{2}$ WAVELENGTH

NSOM: LATERAL RESOLUTION IS LIMITED
BY THE APERTURE SIZE AND DISTANCE FROM
SURFACE: RESOLUTION ON THE NANOSCALE

DIELECTRIC IMAGING: NEAR FIELD MICROWAVE MICROSCOPY

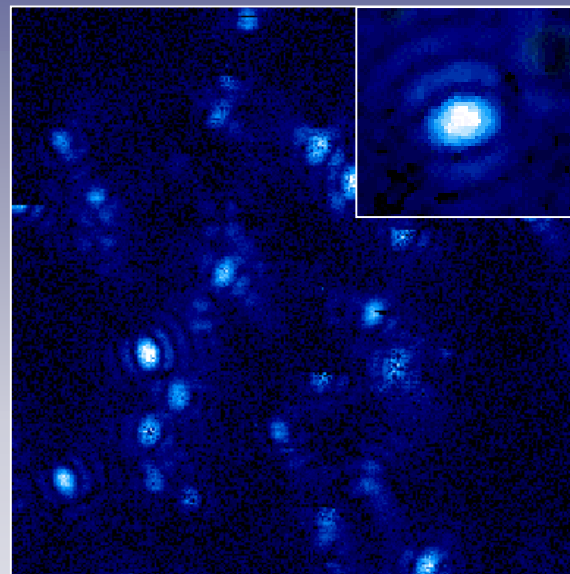
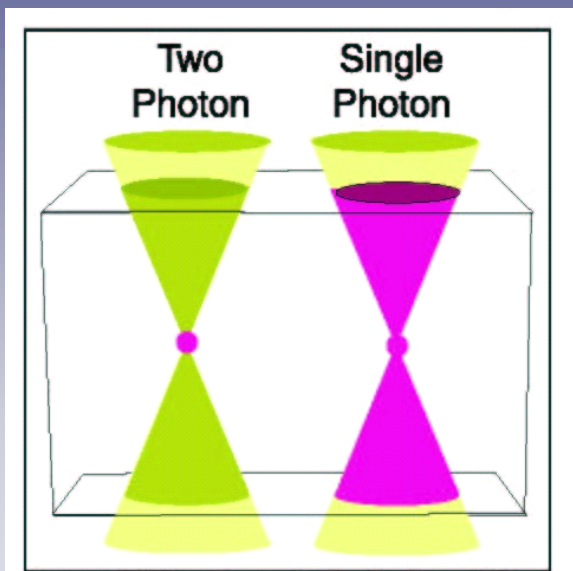
- NEAR-FIELD MICROWAVE MICROSCOPY: TIP LOCALIZES MICROWAVE FIELD
- CONTRAST MECHANISM: DIELECTRIC RESPONSE AT GHZ FREQUENCIES
- SPATIAL RESOLUTION HIGHLY COUPLED WITH SENSITIVITY



3 μm TOPOGRAPHIC AND DIELECTRIC IMAGES OF LEAD ZIRCONATE
TITANATE THIN FILM MICRO-DOMAINS

TWO-PHOTON FLUORESCENCE IMAGING

- CONFOCAL FLUORESCENCE MICROSCOPY WITH TWO-PHOTON EXCITATION
- ELIMINATES SAMPLE DAMAGE ISSUES ASSOCIATED WITH ONE PHOTON UV EXCITATION
- EXCITATION VOLUME SPATIALLY LIMITED YIELDING EXCELLENT SPATIAL RESOLUTION
- RADIAL POLARIZATION FOR ENHANCED SPATIAL RESOLUTION



- SINGLE MOLECULE TWO-PHOTON IMAGES OF DYE MOLECULES IN POLYMER MATRIX
- 10 x 10 μm IMAGES
~ 300 NM SPATIAL RESOLUTION
- CONTRAST REQUIRES CHROMOPHORE

LASER-BASED INFRARED MICROSCOPY

- CONFOCAL INFRARED MICROSCOPY WITH LASER LIGHT SOURCE
- USEFUL FOR BRIGHTNESS LIMITED APPLICATIONS – GRAZING INCIDENCE, DIFFUSE REFLECTANCE
- SPATIAL MODE IMPROVEMENT USEFUL FOR IMAGING APPLICATIONS – ATR, IMMERSION LENS

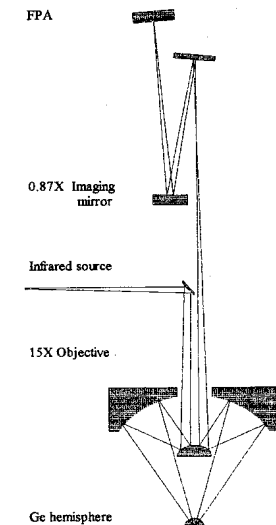
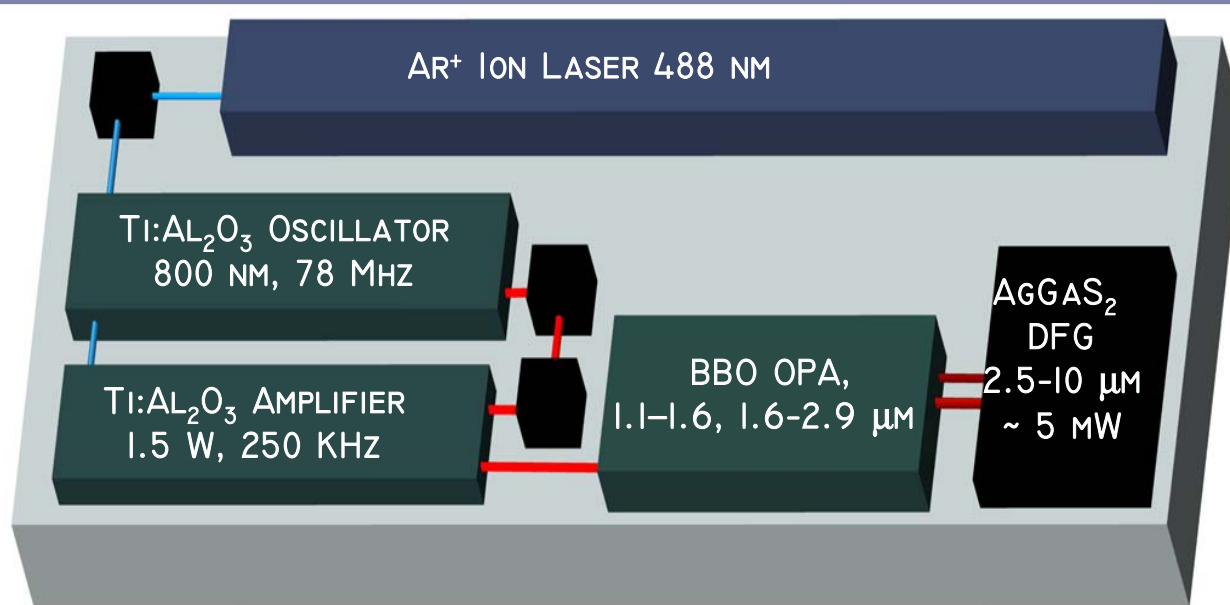


FIG. 1. Optical diagram of the microscope.